

TYPHOON PIPER (20W)

BEST TRACK-TC 20W

19 AUG - 26 AUG 96

MAX SFC WIND 65 KT

MINIMUM SLP 976MB

LEGEND

111 24-HR BEST TRACK POSITION

ooo TROPICAL DISTURBANCE/

TROPICAL DEPRESSION

666 TROPICAL STORM

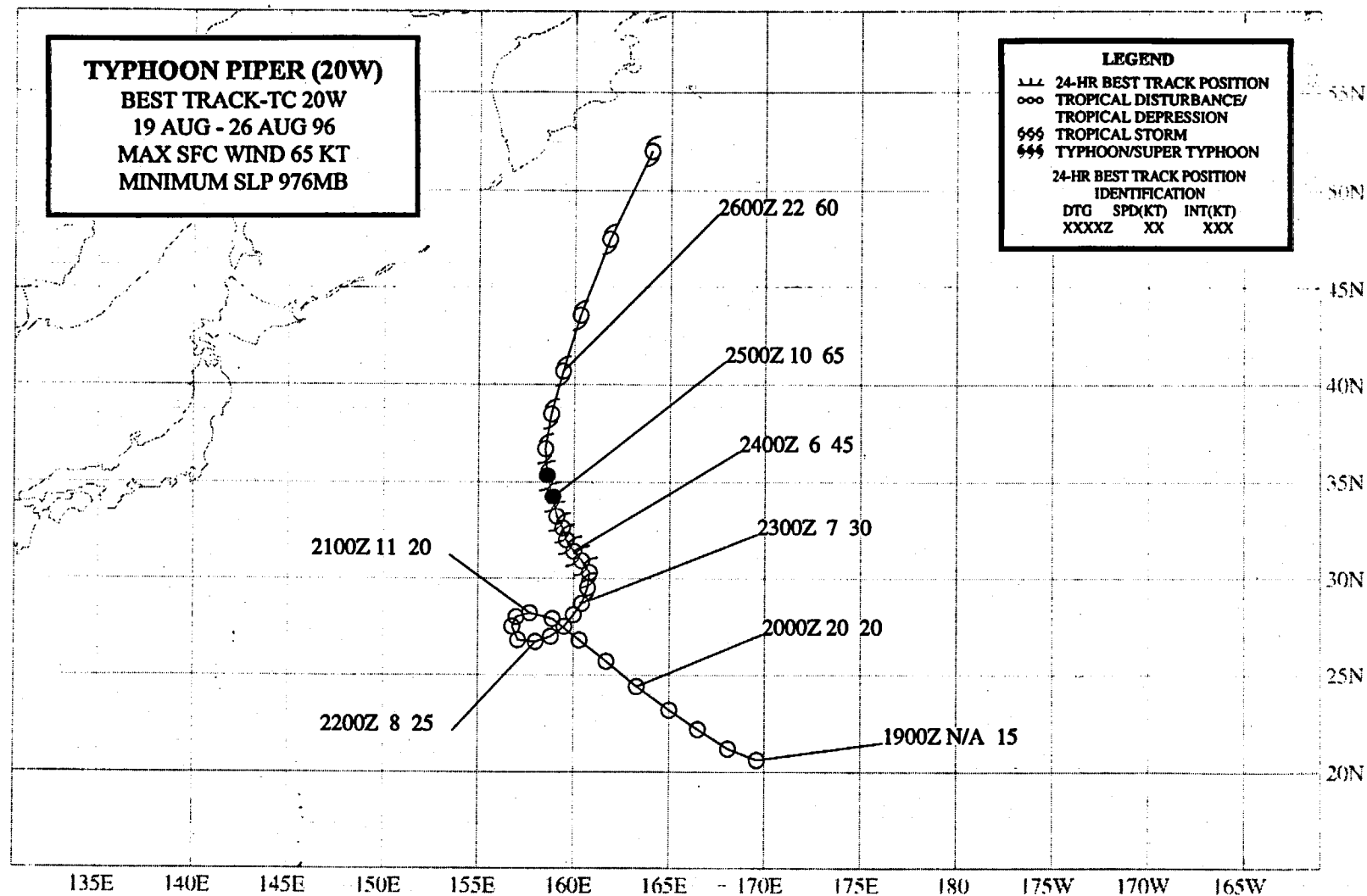
666 TYPHOON/SUPER TYPHOON

24-HR BEST TRACK POSITION

IDENTIFICATION

DTG SPD(KT) INT(KT)

XXXXZ XX XXX



TYPHOON PIPER (20W)

I. HIGHLIGHTS

Piper was another of the TCs of 1996 which originated directly from a TUTT cell. It was a very small TC — the smallest in the WNP during 1996. Developing at a relatively high latitude to the east of Orson (19W), Piper was located at the eastern end of a reverse-oriented monsoon trough (RMT). Typical of TCs associated with a RMT, Piper's motion was north oriented.

II. TRACK AND INTENSITY

During 19 August, a well-defined TUTT cell was moving westward along 25°N and had crossed 165°E. Mesoscale convective systems populated the eastern through northern segment of a curved moisture band that wrapped into this TUTT cell (Figure 3-20-1a). Synoptic data at 190000Z indicated that a weak low-level cyclonic circulation was located west of this cloud band and close to the estimated center of the TUTT cell, prompting its inclusion on the 190600Z August Significant Tropical Weather Advisory. During the next two days, the low-level cyclonic circulation became associated with an area of deep convection. On 22 August, the deep convection consolidated under the anticyclonically curved flow on the eastern side of the TUTT cell, and scatterometry indicated the wind speeds had increased to 20 kt (10 m/sec) on the north side of the accompanying low-level circulation center (LLCC). This prompted JTWC to issue a Tropical Cyclone Formation Alert valid at 221500Z.

On 23 August, persistent deep convection in the eastern quadrant of the TUTT cell became coupled with well-defined anticyclonic flow aloft. The persistence of deep convection and its increased organization prompted the first warning on Tropical Depression (TD) 20W valid at

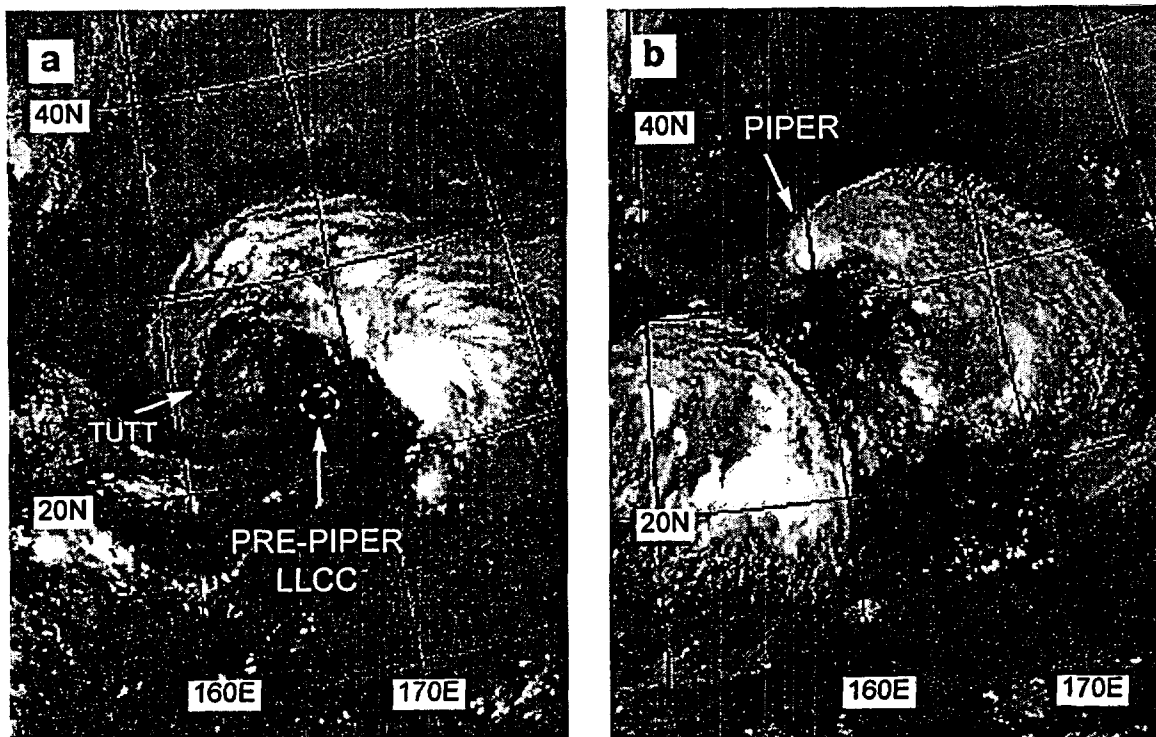


Figure 3-20-1 A westward moving TUTT cell (a) induces the formation of Piper (b). (192131Z August water-vapor GMS imagery and 240031Z August water-vapor GMS imagery respectively).

230000Z. Synoptic data at this time showed the monsoon westerlies had extended to the LLCC of TD 20W, creating a reverse-oriented monsoon trough which included the larger Orson (19W) to the west. Based on a satellite intensity estimate of 35 kt (18 m/sec), TD 20W was upgraded to Tropical Storm Piper on the warning valid at 230600Z. With a ridge located to its southeast, and a blocking high to its northeast, Piper moved on a north-oriented track.

Late on 24 August, Piper's small CDO moved north, became detached from the monsoon cloud band, and intensified. At 250000Z, Piper acquired a visible eye, and reached its peak intensity of 65 kt (33 m/sec) (Figure 3-20-2). Piper retained its small 7-nm (13-km) eye for about 12 hours (Figure 3-20-3a, b). During 26 August, Piper's central convection became a small well-defined CDO (Figure 3-20-4), as it accelerated to the north-northeast and slowly weakened. Late on 26 August, Piper's forward motion increased to more than 40 kt (75 km/hr) as it merged with a frontal cloud band which stretched southward from a low over the Kamchatka peninsula. The final warning was issued valid at 260600Z when Piper's CDO became associated with the frontal cloud band. Post analysis indicated Piper's CDO could be followed for an additional 12 hours as it sped northward within the frontal cloud band, and therefore, the final best track continues until 261800Z.

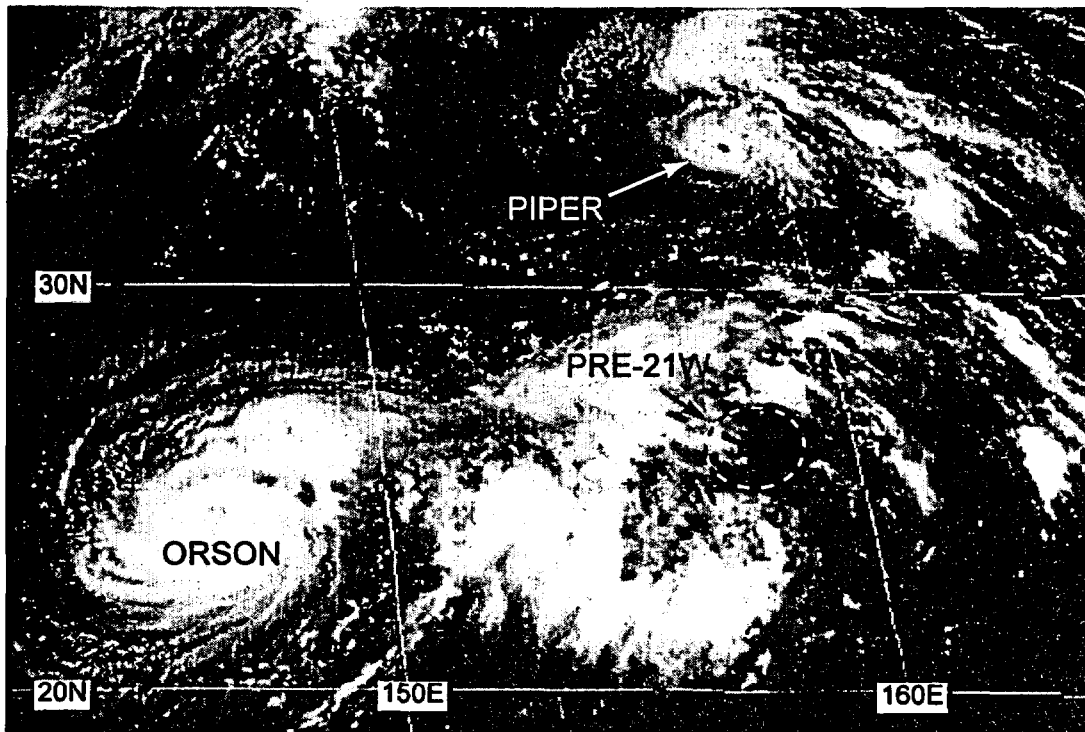


Figure 3-20-2
Piper at its peak
intensity of 65
kt (33 m/sec)
(242331Z
August visible
GMS imagery).

III. DISCUSSION

a. Tropical cyclogenesis induced by a TUTT cell

Piper originated directly from a TUTT cell (see Joy's (12W) summary for a more complete description of tropical cyclogenesis induced directly by a TUTT cell). This is well illustrated by water-vapor imagery (Figure 3-20-1a, b). Water-vapor imagery has only been available since the GMS-5 satellite became operational during June of 1995. It has allowed a greatly improved presentation of TUTT cells, and their movement and evolution can now be studied as never before. Water-vapor imagery should open new opportunities for research on the effects of the TUTT and its associated TUTT cells on TC genesis and TC development.

b. *Small size*

Like most TCs that form at high latitude in association with TUTT cells, Piper was a very small TC — the smallest of 1996. The diameter of its dense cirrus cloud shield was less than 100 nm (185 km) (Figure 3-20-3a, b), and it encompassed a very small eye whose diameter was 7 nm (13 km) on satellite imagery. As with many very small TCs, the intensity forecasts erred on the low side: on the first eight warnings (issued at six-hour intervals from 230000Z August to 241800Z August), the 24-hour intensity was under-forecast by anywhere from 5 to 25 kt; the 48-hour intensity was under-forecast by as much as 30 kt (15 m/sec).

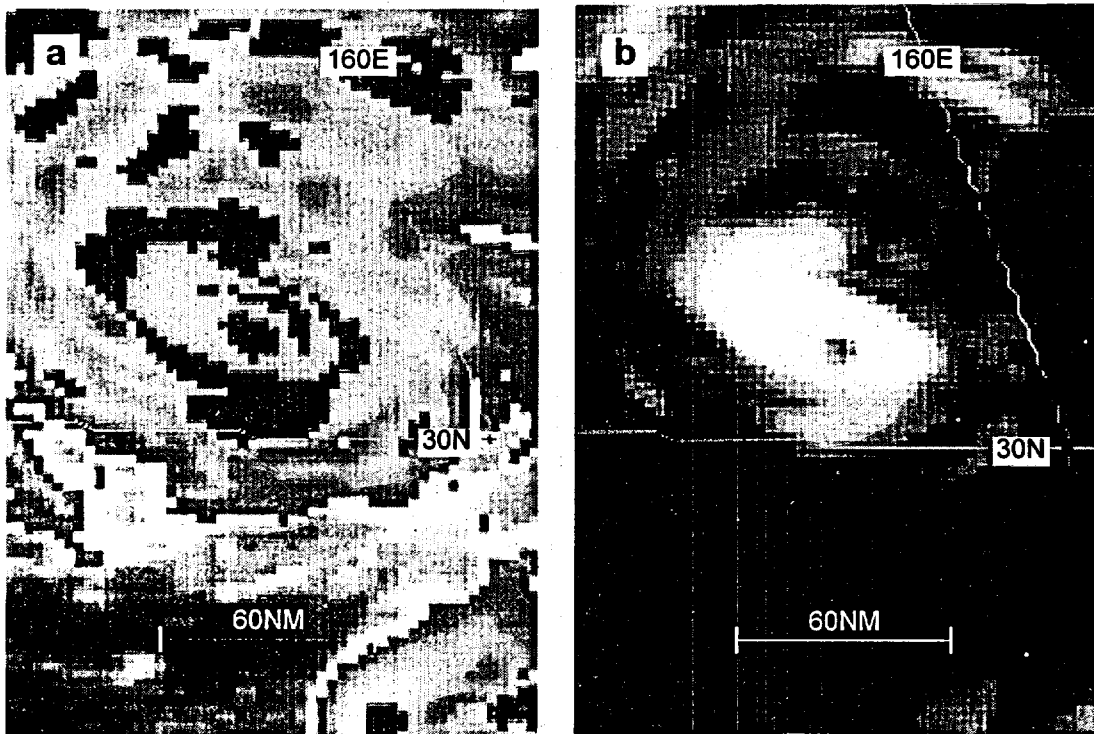


Figure 3-20-3a, b Piper was a very small TC — the smallest of 1996. Its eye was only 7 nm (13 km) in diameter, and its dense cold cirrus shield had a diameter of less than 100 nm (185 km). (a) 250931Z August enhanced infrared GMS imagery, and (b) 250931Z August high-contrast infrared GMS imagery.

c. *Development over cool SST*

Relatively few TCs in the WNP first attain typhoon intensity poleward of 30°N — during the 25-year period 1970 to 1994 only thirty-one of 729 TCs (4%) which formed in the WNP first attained 65-kt (33-m/sec) intensity at, or north, of 25°N; only twelve at, or north, of 30°N; and only one north of 35° N. Piper first attained 65-kt (33-m/sec) intensity at 34°N. It remained a typhoon for approximately nine hours, and fell below typhoon intensity after crossing 35°N. The sea-surface temperature (SST) at the point where Piper's intensity peaked was approximately 25°C (Figure 3-14-5). Piper remained a well-defined TC with an intensity of 60 kt (31 m/sec) near 40°N, (Figure 3-20-4), even though SSTs were only 20°C.

IV. IMPACT

No reports of damage or injury were received at the JTWC.

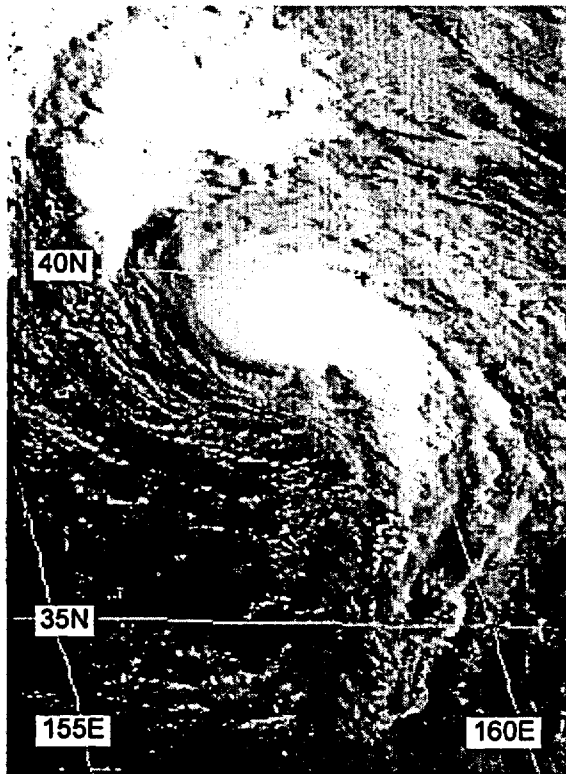


Figure 3-20-4 Piper's small well-defined CDO begins its northward acceleration over cooler SST and toward a frontal cloud band (252131Z August visible GMS imagery).

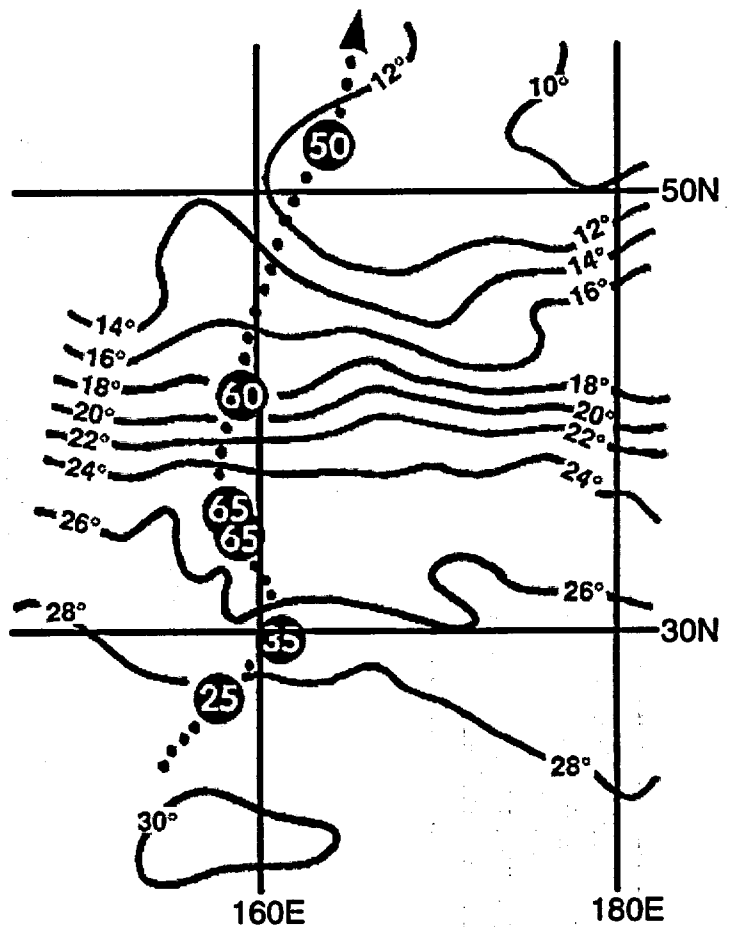


Figure 3-20-5 Piper reaches typhoon intensity at an unusually high latitude, and over relatively cool SST. (SST contours are based upon 220000Z August FNMOC analysis).